http://mri.sdsu.edu/sereno/568

SDSU Systems Neuroscience 568/768

Professor:
Marty Sereno -- email: msereno@sdsu.edu
class time (2022): MWF 9:00-9:50 AM (opt.: F 8:00-8:50 AM)
Learning Glass lecture recording location: SSW 2667
ofﬁce hours: Mon 10-11 or by appt.
lectures Zoom-streamed and recorded, tests on lecture content

Readings/Content:
readings, lecture videos (links, top of course homepage)
background reading (neuroscience reference texts):
background reading (undergrad neuroscience textbooks):

Exams:
multiple question short-answer, each question with several subsections, test pdf link posted at 9 AM on exam day morning, email pics of filled-in exam pages by 11 AM
2 midterms, ﬁnal (midterms: 24% each, ﬁnal: 32%), and short final paper (20%)
old pdf answer keys from my similar UCSD Systems Neuroscience course here and here

Learning Objectives:
Students will be able to do the following:
(1) describe neuronal electrochemistry, development, and relation to simple dendritic, Hebbian, and attractor models
(2) diagram neuroanatomical structures/connections from low to high levels in visual, somatosensory, auditory sensory systems
(3) diagram structures/connections involving superior colliculus, cerebellum, striatum, motor cortex, and limbic systems
(4) analyze sequential processing stages in visual, somatosens., and auditory systems from signals and systems perspective
(5) describe neuronal models of eye movement planning, hierarchical motor control, and body position and orientation
N.B.: consult with me if a disability hinders your performance so we can use University resources to maximize learning

Lecture Topics: (Spring 2022)

Week of Jan 17 (WF) -- Introduction
introduction to course, folk theory of brain function
resting/Nernst/reversal potential

Week of Jan 24 (MWF) -- Cellular Physiology
action potential, voltage-gated channels
voltage-sensitive dendritic currents, bursting neurotrans.-gated post-synaptic potentials, NMDA, LTP/STDP
grad lecture: Hodgkin-Huxley, integrate-and-ﬁre models

Week of Jan 31 (MWF) -- Relation to Neural Models
current ﬂow in dendrites, equivalent circuits
simple Hebbian network model of orientation selectivity
simple attractor network model, energy analysis
grad lecture: covariance/eigenvector analysis Hebbian learning

Week of Feb 07 (MWF) -- Neural Development
blastula, gastrula, neural plate, neural tube, optic cup
cylindrical coords, temporal lobe formation, ‘rule of Sereno'
later development, cortical subplate, gyrification

Week of Feb 14 (MWF) -- Visual System I
retinal circuitry, origin of processing streams
retina to dLGN as a conformal map, layers
visual cortical maps: V1, V2, MT and the rest
grad lecture: cortical area development, achiasmic sheepdog

Week of Feb 21 (MWF) -- Visual System II
cortical layer scheme, edges/brightness/motion in V1
V2 modules, simple/complex/hyper, 1st midterm review
1st Midterm Exam -- Fri, Feb 25

Week of Feb 28 (MWF) -- Visual System III
Gabor ﬁlter model, aperture prob for color, pattern translation
aperture prob complex motion, pos. invariance, contour analog
cortical-wide mechanisms of visual attention
grad lecture: explicit V1-to-MT model, Horn and Schunck

Week of Mar 07 (MWF) -- Somatosensory System
somatosensory receptor types, spinal cord
muscle diagram, ascending paths: dorsal column, spinothalamic
somatosensory cortical areas, discontinuities, plasticity
grad lecture: smoothness constraint, line processes, stereo

Week of Mar 14 (MW) -- Auditory System I
hair cell receptors, lateral line, electric fish
cochlear structure/transduct., 1D vs. 2D, mammalian brainstem
[no classes Fri]

Week of Mar 21 (MWF) -- Auditory System II
cochlear nuclei responses, auditory streams
nucleus laminaris coincidence detection
construction of the owl space map
grad lecture: auditory thalamus, cortex, freq vs. pitch

Week of Mar 28 (no class) -- SPRING BREAK
[Mon/Wed/Fri: no class]

Week of Apr 04 (MWF) -- Motor System I
bat echolocation and speech sound processing
gaze stabilization (VOR, OKN, pursuit)
superior colliculus retinal/motor maps, double-step remapping
grad lecture: bat FM, phonetics, auditory attention

Week of Apr 11 (MWF) -- Motor System II
multisensory map alignment: superior colliculus, VIP, LIP
motor system overview, spinal/brainstem pattern generators
motor cortex, 2nd midterm review
grad lecture: spatial->temp & temp->spatial, WTA, human VIP

Week of Apr 18 (MWF) -- Motor System III
2nd Midterm Exam -- Mon, Apr 18
cerebellum: connections, microanatomy, learning
striatum: connectional/funct overview, hierarchical sequencing
grad lecture: origin of language I: vocal learning

Week of Apr 25 (MWF) -- Limbic System
connectional overview limbic system
hippocampus: H.M./intermed. term memory vs. inertial guidance
head direction and grid cells, attractor models
grad lecture: origin of language II: language and scenes

Week of May 02 (MW) -- Neuroimaging EEG/MEG
source EEG/MEG, MRI, spin vs. precess, Bloch equation
Fourier transform, relation to MRI image formation

May 09 -- Final Exam 8-10 AM
Graduate students: ﬁnal paper due May 13